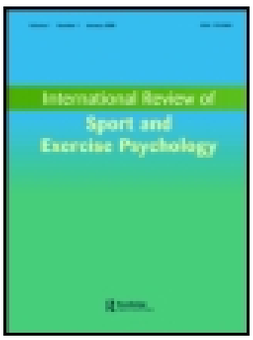
A systematic review of school-based physical activity interventions on children's wellbeing



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REVIEW ARTICLE

A systematic review of school-based physical activity interventions on children's wellbeing

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ABSTRACT

Purpose: The aim of this study was to review the effect of school-based physical activity interventions on children's wellbeing.

Method: A systematic search of school-based physical activity studies was conducted using EBSCOhost PsycInfo, EBSCOhost Medline and Web of Science. Initially 995 studies were retrieved and, following the removal of duplicates, the titles and abstracts of 984 studies were screened. This screening identified 53 relevant studies from which 42 were excluded, resulting in 11 articles being reviewed.

Results: Three studies reported a positive increase in wellbeing; however, only one of those studies also significantly increased physical activity. It was apparent that the measurement of wellbeing and physical activity was inconsistent across studies, making conclusions difficult to draw. The wellbeing measures used neglected to account for the children's perspectives of wellbeing.

Conclusions: The effect of a physical activity intervention on increasing wellbeing appears to be more complex than originally believed. The complexity may in part be due to methodological issues and the choice of wellbeing and physical activity measurement. We recommend that future physical activity interventions include a measure of wellbeing developed from the child's perspective, and that future reviews narrow the search to only interventions that have had success at increasing physical activity before exploring effects on wellbeing.

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Quality of life; intervention; health promotion; education; public health

Introduction

Wellbeing is considered an important aspect of health to individuals and to society (World Health Organisation, 2006) with the United Kingdom (UK) Government including well-being as a marker of health within the nation (Cameron, 2010). Children in the United Kingdom (UK) have lower levels of wellbeing than many of their peers in other developed countries, after being positioned 14th out of 29 countries (United Nations International Children's Emergency Fund, UNICEF, 2013). The consequences of lower levels of wellbeing are broad, including associations with poor mental health, involvement in risky behaviour and social isolation among others (Friedli, 2009; Rees, Bradshaw, Goswami, & Keung, 2010).

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Furthermore, the absence of negative symptoms of wellbeing may not equate to the presence of positive wellbeing, such as happiness and life satisfaction (Huppert & Whittington, 2003). A positive wellbeing may provide additional benefits, such as reducing the onset of mental health disorders (Park, 2004), enhancing relationships with others (Friedli, 2009; Rees et al., 2010) or greater attainment in education (Rees et al., 2010). Therefore, when determining one's wellbeing, it is important to consider both the positive and negative dimensions of wellbeing. Although there is no universally accepted definition of child wellbeing (Pollard & Lee, 2003), the most recognised definition proposed by Diener (1984) incorporates subjective evaluations of psychological, physical and social health implying that wellbeing is multidimensional (Pollard & Lee, 2003). Considering the broad nature of wellbeing, it is unsurprising that a myriad of factors potentially influence a child's wellbeing such as gender, socioeconomic status, weight status (Hartmann, Zahner, & Puhse, 2010) and physical activity (Biddle, Fox, & Boutcher, 2000). Physical activity is the focus of this review.

Physical activity is defined as any bodily movement produced by skeletal muscles that require energy expenditure (Casperson, Powell, & Christenson, 1985). In children, the promotion of physical activity is considered a public health priority as children are insufficiently active. Data from five European countries reported that only 4.6% of girls and 16.8% of boys aged 10–12 years met the moderate to vigorous intensity physical activity (MVPA) guidelines for health (Verloigne et al., 2012). Yet children who reported high levels of physical activity scored lower in depression (Cheung, Mak, & Chan, 2008; Parfitt, Pavey, & Rowlands, 2009; Tomson, Pangrazi, Friedman, & Hutchinson, 2003) and anxiety (Parfitt et al., 2009) but higher in vigour (Cheung et al., 2008), physical self-worth (Parfitt et al., 2009) and global self-esteem (Parfitt & Eston, 2005), as well as a better quality of life (Sanchez-Lopez et al., 2009). Furthermore, those who met the recommended daily physical activity guidelines for health of at least 60 minutes of MVPA each day (Department of Health, Physical Activity, Health Improvement and Protection, 2011) scored higher on measures of wellbeing than less active children (Breslin et al., 2012). Beneficial effects of physical activity interventions on wellbeing in children have been reported with a small effect size in favour of physical activity reducing depression and anxiety (Larun, Nordheim, Ekeland, Hagen, & Heian, 2006) and a moderate effect size showing increases in self-esteem, at least in the short term (Ekeland, Heian, & Hagen, 2005). Therefore, continued promotion of physical activity is needed to increase children's activity levels for health benefits.

Despite the beneficial effects of physical activity interventions on children's wellbeing, the evidence for children is not as convincing as it is for adults, potentially because the few interventions that have been conducted have low methodological quality research designs (Biddle & Asare, 2011) and measurement limitations (Parfitt & Eston, 2005). A systematic review of child wellbeing found that wellbeing was inconsistently measured, was narrowly focused and used mainly negative indicators (Pollard & Lee, 2003). Yet the definition of wellbeing implies that it is a multidimensional concept that encompasses both positive and negative indicators (Pollard & Lee, 2003). Equally, self-report measures of physical activity have been widely used in children's physical activity as they are easy to administer and low in cost (Biddle, O'Connell, & Braithwaite, 2011). However, self-report measures cannot accurately assess every bout of activity engaged in because children are likely to have difficulty recalling their physical activity from the previous week due to a less developed cognitive ability than adults (Chinapaw, Mokkink, van Poppel, van Mechelen, & Terwee, 2010). In order to overcome the limitations of self-report, objective

measures of physical activity have been utilised, with accelerometers being the most precise measurement tool for children's activity (Mattocks et al., 2008). Based on these observations, one aim of this review is to consider the measurement of wellbeing and physical activity in intervention studies to provide recommendations when selecting an appropriate measurement tool.

School-based settings are considered ideal for targeting children's health as they provide access to a large number of children across broad socioeconomic strata without having to discriminate or stigmatise (Fox, Cooper, & McKenna, 2004) and with less chance of poor adherence to the intervention programme (Harris, Kuramoto, Schulzer, & Retallack, 2009). Many school-based physical activity intervention programmes have shown success at increasing physical activity, as evidenced by a review by Kriemler et al. (2011), whereby all 16 intervention trials reported an increase in physical activity either in school or out of school or in nine out of 10 studies for overall physical activity. These results indicate that school-based physical activity promotion is an effective strategy to increase physical activity levels in children.

In contrast, reviews of school-based interventions on children's wellbeing have reported mixed findings. Van Wijnen, Wendel-Vos, Wammes, and Bemelmans (2009) investigated the extent to which psychosocial wellbeing was affected by school-based obesity prevention programmes of children and adolescents with the rationale being that some psychosocial problems have been correlated with obesity/overweight and that interventions aiming to reduce body weight may show positive effects on psychosocial wellbeing (van Wijnen et al., 2009). No firm conclusions could be derived due to the small number of studies found, and the wellbeing measures used differed between studies, making comparison difficult. In contrast, a meta-analysis found, when analysing different settings of physical activity interventions and their effect on child mental health, that school-based interventions had the greatest effect on mental health in children aged 3–18 years (Ahn & Fedewa, 2011). However, the interventions reviewed in van Wijnen et al. (2009) targeted obesity prevention/reduction, and hence they did not have to include physical activity. Moreover, no previous reviews considered whether school-based interventions significantly increased physical activity and consequently what effect this had on wellbeing. It seems important to consider whether the intervention significantly increased physical activity in order to determine what effect increased activity levels have on children's wellbeing. Hence, the current review investigated the effect of school-based physical activity interventions on the physical activity levels and wellbeing of children, which had not previously been investigated.

The primary aim of this review was to determine the effect of school-based physical activity interventions on children's physical activity levels and their wellbeing. Secondly, the review also took the measurement of wellbeing and physical activity into consideration by highlighting the methodological importance of choosing a suitable, valid and reliable measure of both variables for future studies.

Method

Search strategy

This systematic review follows the search strategy as recommended by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al.,

Table 1. Categories and search terms for the literature search.

Category	Search terms
Population	Child; student; pupil; boy; girl
Setting	Primary school; elementary school; middle school
Method of treatment	Physical activity; exercise; fitness; sport; physical education; aerobic exercise; training; lifestyle; walk; intervention; school based intervention; programme; experiment; education; evaluation
Objective of treatment	Well-being; wellbeing; quality of life; wellness; psychological wellbeing; happiness; life satisfaction; self-esteem; self-concept; body image; physical appearance; anxiety; depression

2015). A systematic search was carried out in January 2016 in the following databases: EBSCOhost PsycInfo, EBSCOhost Medline and Web of Science. Each database was searched from the year of their inception to January 2016. The search used relevant indexing and text words of the search terms, adjusting for each database. Table 1 shows the categories and search terms used for the literature search. Wellbeing is considered a complex and multidimensional concept that encompasses both positive and negative indicators (Pollard & Lee, 2003) and could be defined by the inclusion of a broad range of constructs, including many mental health disorders, behaviour problems, symptoms of depression, anxiety, life satisfaction and happiness among others. However, it is not feasible to conduct a review of such broad magnitude. Therefore, for the purposes of this review, wellbeing was defined based on the variables of wellbeing listed in Table 1. These included the most widely measured variables of wellbeing in physical activity and wellbeing studies in children – that is, depression and anxiety (Biddle & Asare, 2011), which represented negative indicators in the search strategy, while the search terms used in a review of child wellbeing represented the positive indicators of wellbeing (Pollard & Lee, 2003). Body image and physical appearance were also included. The physical activity search terms utilised were similar to those used in a previous review of school-based physical activity interventions (Kriemler et al., 2011). In an attempt to ensure that articles using slightly different search terms for each category were not omitted, the search terms included various suffixes and synonyms of these terms. Initially, articles were screened based on the content of the title and abstract and assessed for their relevancy. The full text of potentially suitable articles were retrieved. Reference lists of review studies and retrieved articles were scanned for additional articles. All identified articles were reviewed in detail based on the inclusion/exclusion criteria. The first author selected the studies. If there was any uncertainty regarding selection criteria, then the second author was consulted.

Criteria for inclusion/exclusion

The eligibility of the studies for inclusion was assessed using the following criteria: (a) must include physical activity as a component of the intervention; (b) the intervention is school based; (c) participants were aged 6–12 years old (preadolescent); (d) wellbeing and physical activity of children is reported pre and post intervention; (e) the studies are of quantitative research using an experimental/quasi-experimental design; (f) published peer reviewed articles only; and (g) articles published in the English language. The exclusion criteria include (a) studies that investigate specific populations, such as persons with physical or mental disabilities, children with critical illness, eating disorders, asthma, diabetes or mental disorders and studies focusing specifically on treatment of obese children in clinical settings; (b) interventions that are family or community based.

Risk of bias assessment

Studies were assessed for risk of bias using criteria from the Cochrane Handbook for Systematic Reviews of Interventions (Version 5.1.0; Higgins, Altman, & Sterne, 2011). The criteria include six domains from which an estimation of the risk of bias for each domain was given for each study included in the review. The six domains include selection bias (random sequence generation, allocation concealment), performance bias (blinding of participants and personnel), detection bias (blinding of outcome assessment), attrition bias (incomplete outcome data), reporting bias (selective reporting) and other sources of bias.

Characteristics of the selected intervention studies

A detailed extraction of relevant information from each of the selected studies was conducted. The information retrieved included the authors, the study design, the sample size and age, the duration and frequency of the intervention and a description of the intervention. The measurements retrieved were: the indicator(s) of wellbeing and physical activity and the corresponding measurement tools used, and whether or not the intervention had a significant effect on physical activity levels and the wellbeing indicator(s).

Results

The search strategy identified 995 studies (109 from Medline; 67 from PsychInfo; 816 from Web of Science and three from a hand search of reference lists from review studies and retrieved studies; see Figure 1). After the removal of duplicates ($n = 11$), the titles and abstracts of 984 studies were screened. This screening identified 53 relevant studies, which were obtained as full text articles. Consequently, the full text of 53 studies was screened in detail using the pre-established inclusion criteria of the review.

From the 53 studies, 42 were excluded based on the following criteria: Ten studies did not measure a construct of wellbeing relevant to this review (as listed in Table 1), four studies were study protocols, four studies were not school-based, four studies had no physical activity in the intervention, 13 studies did not measure physical activity, three studies were qualitative, three studies were cross-sectional in design and one study was a quasi-experimental time series and measured wellbeing of different children once a year over 6 years, hence did not include pre and post measures of wellbeing. Finally, 11 studies were identified that met the inclusion criteria.

Risk of bias assessment

The estimated risk of bias of each of the interventions included in our review is summarised in Table 2. In general, the risk of bias was high in studies based on random sequence generation, concealment and blinding of the intervention condition of participants and personnel involved. Although six of the 11 studies were randomised controlled trials (RCTs), only four studies described the process of randomisation (Ha et al., 2015; Hartmann et al., 2010; Meyer et al., 2014; Sahota et al., 2001). Across the domains, five studies had the highest risk of bias. In general, a low risk of bias appeared to be more frequent on the selective outcome reporting, the outcome of incomplete data and the risk of other

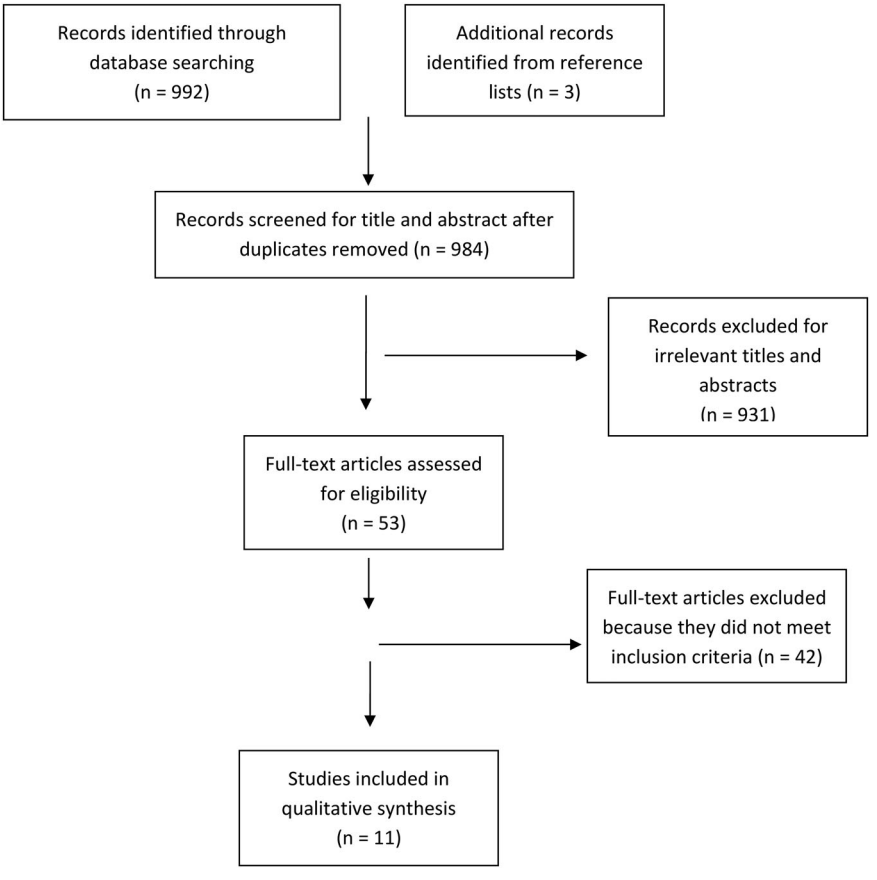

Figure 1. Flow chart of the study inclusion selection process.

types of bias. Across the domains, Sahota et al. (2001), Ha et al. (2015) and Meyer et al. (2014) were estimated to have the lowest risk of bias while an unclear risk of bias was estimated for the blinding of outcome assessment in almost all of the studies.

Characteristics of the intervention studies

The extracted information and the findings of the included studies are presented in Tables 3 and 4. All interventions included either physical activity only (three studies) or physical activity as part of a multicomponent or broader programme (eight studies). Four studies contained a nutrition component (Elinder et al., 2012; Gorely et al., 2009; Sahota et al., 2001; Stock et al., 2007), one study included educational advice to develop a healthy body image (Stock et al., 2007), while four interventions highlighted the importance of physical activity for health (Boyle-Holmes et al., 2010; Elinder et al., 2012; Gorely et al., 2009; Sahota et al., 2001). In addition, four of the interventions engaged the families through homework with a physical activity component (Gorely et al., 2009), through information leaflets (Gorely et al., 2009; McNeil et al., 2009; Sahota et al., 2001) and via parent information evenings (McNeil et al., 2009). Two interventions focused on modifying the

Table 2. Summary of the estimated risk of bias for the 11 studies included.

Study	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	Other bias
Hartmann et al. (2010)	+	?	?	?	?	+	+
Gorely, Nevill, Morris, Stensel, and Nevill (2009)	–	–	?	?	+	+	+
Sahota et al. (2001)	+	?	–	?	+	+	+
Stock et al. (2007)	–	–	–	?	–	+	+
Boyle-Holmes et al. (2010)	–	–	–	?	+	+	+
McNeil, Wilson, Sliever, Ronca, and Mah (2009)	?	?	–	?	–	+	+
Elinder, Heinemans, Hagberg, Quetel, and Hagströmer (2012)	–	–	–	?	+	+	+
Hyndman, Benson, Ullah, and Telford (2014)	–	–	–	?	+	+	+
Ha, Burnett, Sum, Medic, and Ng (2015)	+	?	?	?	+	+	+
Meyer et al. (2014)	+	?	+	?	+	+	+
Wood, Gladwell, and Barton (2014)	–	–	–	?	+	+	+

+: low risk of bias; ?: unclear risk of bias; –: high risk of bias.

playground area (Hyndman et al., 2014; Wood et al., 2014) while one study promoted skipping as physical activity (Ha et al., 2015).

Six of the interventions were randomised controlled trials (Table 3). The control groups engaged in their regular physical education classes for all interventions. Sample sizes varied greatly from a baseline total of 25 to 1464 children while the duration of the interventions ranged from five weeks up to two years. Finally, the frequency of the interventions was predominantly three times a week, with some interventions occurring twice a week or every day while others were flexible as to the teacher's/instructor's discretion. Two studies did not specify the frequency of the intervention (McNeil et al., 2009; Sahota et al., 2001).

Assessment of wellbeing

There were 13 different indicators of wellbeing assessed throughout the studies and 12 different measures used (see Table 4). Two studies used the Child Health Questionnaire (CHQ-PF50) of which one study used the parent proxy version of the questionnaire. Two studies used the Self-Perception Profile for Children (Harter, 1985), while three studies used the Perceived Competence Scale for Children (Harter, 1982).

Assessment of physical activity

Physical activity was assessed by objective or subjective tools (see Table 4). Six studies measured physical activity using objective measures – that is, accelerometers or pedometers. Five studies measured physical activity using self-report questionnaires.

Table 3. Characteristics of the selected intervention studies.

Author	Research design, sample size and age	Intervention description
Hartmann et al. (2010)	Cluster RCT; $n = 540$; age: 1st grade (6–8 years), 5th grade (10–12 years); SES: all levels	Multicomponent intervention (KISS) consisted of increasing physical activity during school, school breaks and at home every day for 1 year.
Gorely et al. (2009)	Non-RCT; $n = 589$ age: 7–11 years	Multicomponent lifestyle intervention aimed to increase physical activity through classroom sessions, highlight events and outreach to families and promote healthy eating over 10 months. Delivery was flexible for teachers.
Sahota et al. (2001)	Group RCT; $n = 634$; age: 7–11 years	Multicomponent intervention (APPLES) designed to influence physical activity and diet by developing and delivering school plans to promote PA and healthy eating via teacher training and modification of school meals over 1 year.
Stock et al. (2007)	CT; $n = 383$; age: 4–12 years	Intervention (Healthy Buddies) targeted being physically active, eating healthy foods and having a healthy body image by pairing children in 4th–7th grade (9–12 years) with children in kindergarten–3rd grade (4–8 years), acting as peer educators in these components 2/3 hours per week over 21 weeks.
Boyle-Holmes et al. (2010)	QET; $n = 1464$; age: 4th grade (8–10 years), 5th grade (10–12 years)	Intervention lessons focus on motor skill and movement, values of physical activity for health and enjoyment and regular physical activity (EPEC; Michigan's Exemplary Physical Education Curriculum) twice a week for 2 years.
McNeil et al. (2009)	Cluster RCT; $n = 316$; age: 8–12 years; SES: low	Intervention involved support and outreach to children and families to engage in PA providing support and additional information over 1 year.
Elinder et al. (2012)	QET; $n = 687$; age: 6–16 years	SCIP-school intervention aimed to improve students' diet, physical activity and self-esteem and promote the development of healthy body weight by developing school health teams that promote health, diet and health, physical activity and health, mental health, and outdoor education over two years.
Hyndman et al. (2014)	Controlled trial; $n = 275$; age: 8–12 years	The LEAP intervention, which included movable/recycled materials, was designed based upon the social–ecological model. Children could play with these materials during breaks in school.
Ha et al. (2015)	RCT; $n = 1386$; age: 12 years	The STAR project aimed to promote skipping in school settings over 4 weeks. A 3-day skipping workshop taught teachers and student sport leaders how to promote skipping in school.
Meyer et al. (2014)	Cluster RCT; $n = 289$; age: 6–12 years; SES: all levels	3-year follow-up of KISS intervention (Hartmann et al., 2010)
Wood et al. (2014)	RCT; $n = 25$; age: 8–9 years	Children were randomly allocated to play in either the school field or the playground during breaks at school. Children could be as active as they chose in the environment.

$n = 11$. SES = socioeconomic status; RCT = randomised controlled trial; APPLES = active programme promoting lifestyle in schools; SCIP = stockholm county implementation programme; LEAP = lunchtime enjoyment activity and play; STAR = school-based; train-the-trainers; accessibility of resources; recreational; CT = controlled trial; QET = quasi-experimental trial; PA = physical activity.

Effect of interventions

For eight of the 11 studies, the authors reported a significant intervention effect on physical activity (see Table 4). Five of the eight interventions used objective measures of physical activity while the remaining three used a questionnaire. Eight of the 11 studies reported no significant intervention effect on any wellbeing indicator (depicted as 'ns' in Table 4). In the APPLES study, the only significant difference in wellbeing variables was a small increase in global self-worth for obese children in the intervention group (Sahota et al., 2001). First-grade children of an intervention group produced a significant difference in their psychosocial quality of life scores post intervention ($p < .05$) in

Table 4. Results of included intervention studies examining significant effects on children's physical activity and wellbeing.

Author	Measure of wellbeing	Physical activity measure	Main findings on physical activity & wellbeing
Hartmann et al. (2010)	Physical and psychosocial quality of life: CHQ-PF50	Accelerometer: Total PA, in school, out of school, total MVPA, MVPA in school, MVPA out of school	Total PA: *ns*. Total PA in school: I group significantly higher ($p < .005$) Total PA out of school: *ns*. Total MVPA: I group significantly higher ($p < .05$); total MVPA in school: I group significantly higher ($p < .001$); total MVPA out of school: *ns* 1st graders: Psychosocial QoL: I significant effect ($p < .05$) 1st and 5th graders: Physical QoL: *ns* 5th graders: Psychosocial QoL: *ns*
Gorely et al. (2009)	Perceived physical self-competence: PSPP-C	PA: all participants wore a pedometer. 50% of children wore an Actigraph accelerometer for a week pre/post to assess MVPA	PA (pedometer): I significantly increased number of steps in comparison to control ($p < .001$) PA (accelerometer): I significant increase in MVPA compared to control. Perceived physical self-competence: *ns*
Sahota et al. (2001)	Self-perception: SPPC Body image: BSS	PA and sport in the last week (questionnaire)	PA: *ns* Global self-worth: small increase in obese children in I Athletic competence: *ns* Social acceptance: *ns* Physical appearance: *ns* Behavioural conduct: *ns* Scholastic competence: *ns* Body image: *ns* Dietary restraint: *ns*
Stock et al. (2007)	Perceived self-competence: PCS Perceived body image: FRS	Self-report measure of healthy living including PA: Healthy Living Questionnaire (HLQ)	Self-competence: *ns* Body image: *ns* Health behaviour: Kindergarten–3rd grade: *ns* 4th–7th grade: significant increase in health behaviours compared to control group ($p = .025$)
Boyle-Holmes et al. (2010)	Perceived physical activity competence : PCS	Self-report measure of physical activity: Self-Administered Physical Activity Checklist (SAPAC)	Perceived physical activity competence: *ns* PA: 4th grade I PA levels significant increase compared to control ($p < .01$) PA: 5th grade: *ns*
McNeil et al. (2009)	Self-esteem: Self-Esteem Index (SEI)	Self-report measure of physical activity: The Children's Assessment of Participation and Enjoyment (CAPE)	Self-esteem: *ns* PA: I twice as likely to increase PA compared to control group (RR 2.1, $p = .23$)
Elinder et al. (2012)	Global self-worth: the Global Self-Worth subscale of Harter's Self-Perception Profile Wellbeing: questionnaire	Self-report measure of physical activity: questionnaire	PA: *ns* Global self-worth: *ns* Wellbeing: *ns*

(*Continued*)

Table 4. Continued.

Author	Measure of wellbeing	Physical activity measure	Main findings on physical activity & wellbeing
Hyndman et al. (2014)	Physical health scale quality of life Psychosocial scale quality of life Overall quality of life: PEDS QL 4.0	Objective measure of PA: pedometer Moderate and vigorous physical activity: direct observation	Pedometer: I group significantly greater mean steps per minute than the control school ($p < .001$) I group significantly greater distance per minute than the control school ($p < .001$) Moderate activity: *ns* Vigorous activity: I group significantly higher than the control school ($p < .001$) Physical health scale quality of life: *ns* Psychosocial scale quality of life: *ns* Overall quality of life: *ns*
Ha et al. (2015)	HRQOL: KIDSCREEN-27	Objective measure of PA: Actigraph Accelerometer (mean minutes in MVPA)	MVPA: C group had higher levels MVPA than the I group. Physical Wellbeing: *ns* Psychological Wellbeing: *ns* Autonomy & Parent Relation: Group difference: I higher than control group ($p < .05$) Peers & Social Support: *ns* School Environment: *ns*
Meyer et al. (2014)	Physical and psychosocial quality of life: CHQ-PF50	Accelerometer: Total PA, total moderate-to-vigorous physical activity (MVPA)	PA: *ns* Physical QoL: *ns* Psychosocial QoL: *ns*
Wood et al. (2014)	Self-esteem: Rosenburg scale	Objective measurement of PA (time spent in MVPA): accelerometer	MVPA: Field MVPA significantly greater than playground MVPA ($p < .001$) Self-esteem: *ns*

$n = 11$. WB = wellbeing; PA = physical activity; MVPA = moderate-to-vigorous physical activity; I = intervention group; C = control group; *ns* = not significant; CHQ-PF50 = Child Health Questionnaire; PSPP-C = Physical Self-Perception Profile for Children; SPPC = Self-Perception Profile for Children; BSS = Body Shape Perception Scale (adapted); PCS = Harter Perceived Competence Scale for Children; FRS = Figural Rating scale; SEI = Self-esteem Index; PEDS QL = Paediatric Quality of Life Inventory 4; HRQOL = Health Related Quality of Life.

comparison to the control group following a one-year physical activity intervention, while the fifth-grade children reported no significant difference (Hartmann et al., 2010). An intervention group reported higher levels of autonomy and parent relationships post intervention following a school-based intervention promoting skipping to children (mean age = 12 years; Ha et al., 2015). Although significant changes were found for physical and cognitive competence subscale scores for children in the Healthy Buddies study, these were for both the intervention and control groups. No significant changes could be attributed to the intervention (Stock et al., 2007).

From the three interventions that reported significant intervention effects on a well-being indicator, one study reported a significant increase in physical activity for the intervention group (Hartmann et al., 2010), one study reported no significant interaction effect (Sahota et al., 2001), while one study unexpectedly found a significant increase in physical activity in the control group in comparison to the intervention group (Ha et al., 2015).

Discussion

The purpose of this review was to investigate the effect of school-based physical activity interventions on children's physical activity levels and their wellbeing, taking into consideration the measurement of wellbeing and physical activity. In all, 11 school-based physical activity interventions that assessed an aspect of wellbeing on primary school children were found. From these, three studies reported a significant positive effect on an indicator of wellbeing while eight studies reported no statistically significant effect. Furthermore, eight studies reported a significant increase in physical activity while three studies reported no significant effect. There was considerable heterogeneity in the measures of wellbeing used, and no specific types of wellbeing variables were more positively affected by the interventions than other wellbeing variables.

The school-based physical activity interventions in this review aimed at increasing physical activity by incorporating any aerobic activity, exercise, physical education or physical training component into an intervention. Although eight of the 11 studies reported a significant increase in physical activity, only one of those studies reported a significant increase in an indicator of wellbeing (Hartmann et al., 2010). Unexpectedly, Ha et al. (2015) found that the control group had significantly higher physical activity than the intervention group following the intervention. As students in the control group had greater levels of physical activity at baseline, it was suggested that the control group were much more active in general, even after adjusting for baseline values (Ha et al., 2015). Despite the control group achieving greater physical activity levels, a main effect for group for the Autonomy and Parent relation subscale was found for children in the intervention group who scored higher than the control group (Ha et al., 2015). This finding suggests that the Autonomy and Parent subscale may not be affected by increased levels of physical activity. However, as physical activity was only measured during school hours it is unclear whether the intervention group were more active outside of school, which may have had an effect on the wellbeing indicator.

Improvements in wellbeing were found in two studies where the child's wellbeing at baseline may have been considered low. Sahota et al. (2001) reported a small increase in global self-worth for obese children but not children of healthy weight in the intervention schools, while a significant effect on psychosocial wellbeing was found in overweight

first-grade children (Hartmann et al., 2010). These findings support previous research on overweight and sedentary children following separate after-school and hospital-based physical activity interventions (Kemp & Pienaar, 2010; Petty, Davis, Tkacz, Young-Hyman, & Waller, 2009). Previous research highlighted a negative relationship between overweight/obesity and aspects of a child's wellbeing such as self-perceptions of social acceptance and physical appearance (McCullough, Muldoon, & Dempster, 2009; Ottova, Erhart, Rajmil, Dettenborn-Betz, & Ravens-Sieberer, 2012). Therefore, it is possible that overweight/obese children could have lower levels of wellbeing at baseline and could benefit more from the intervention than children whose levels of wellbeing were already high.

For the seven studies that significantly increased physical activity in the intervention group, five of these are multicomponent studies. This is in line with the review by Kriemler et al. (2011) who also found that multicomponent school-based physical activity interventions were more successful at increasing physical activity. Interestingly, interventions that included wellbeing components would expect to show positive intervention effects but non-significant results were reported. The Healthy Buddies intervention contained a component on healthy body image but found no significant differences between the intervention and control groups (Stock et al., 2007). A suggested reason for this was a potential ceiling effect for the baseline wellbeing scores of this middle-class population, while it was also suggested that the sample size was too small to determine whether those with extreme scores had benefited from the intervention (Stock et al., 2007). Similarly, Elinder et al. (2012) included a component on mental health and suggested that the lack of effects might be caused by low implementation of the component by the school, by the information not being comprehensive enough or that the effects may have worn off after two years (post-measures).

The mixed findings on wellbeing reported from the studies included in this review may be attributed to the inconsistent measurement of child wellbeing. A previous systematic review of child wellbeing also observed that child wellbeing was inconsistently measured (Pollard & Lee, 2003). This is in line with Biddle and Asare (2011) who suggested that measurement inconsistencies may contribute to the weak physical activity and mental health relationship in children. In the current review, many of the studies used narrow measures of wellbeing, such as self-perception, which is consistent with Biddle and Asare (2011) who observed that research in this field has focused on depression, anxiety and self-esteem. However such approaches have been criticised for not capturing the multidimensional nature of wellbeing, with Pollard and Lee (2003) calling this 'bait and switch' tactics, whereby wellbeing is mentioned in the title of the article yet only a single domain of wellbeing is assessed and if so with primarily deficit indicators. Furthermore, as researchers chose which aspects of wellbeing to measure, it is likely that the indicators chosen may not fully reflect how a child perceives their own wellbeing. Some differences between children's and adults' views of child wellbeing have been reported in one study (Sixsmith, Nic Gabhainn, Fleming, & O'Higgins, 2007). Furthermore, children as young as seven years old consider wellbeing a multidimensional concept that includes feelings of both sadness and happiness (Fattore, Mason, & Watson, 2007; Nic Gabhainn & Sixsmith, 2005), mirroring Diener's (1984) definition of wellbeing. This is in contrast to the narrow focus of indicators used in the school-based interventions. Hence, the measures of wellbeing chosen in the reviewed interventions may not best reflect a child's wellbeing.

Therefore, it is not inconceivable to consider that the mixed results on wellbeing found in this review may be because a measure based on the child's view was not used and that adopting the use of such a measure that is more valid and reliable will yield more accurate intervention effects on wellbeing.

In addition, the measure of physical activity used may have also had an impact on the findings. Five of the 11 studies used a self-report measure of physical activity, of which three reported a significant increase in physical activity but no significant effect on wellbeing. As self-report measures are prone to error and recall bias due to the sporadic nature of children's movement and their difficulty remembering when and how intense their activity was (Baquet, Stratton, van Praagh, & Berthoin, 2007; Chinapaw et al., 2010), the use of an objective measure of physical activity, such as an accelerometer, may provide a clearer understanding of the effects. However, five of the studies that reported a significant increase in physical activity used objective measures, with only one study reporting a positive effect on wellbeing. Clearly, the effects of school-based physical activity interventions on wellbeing are complex, and both the measures of wellbeing and physical activity should be considered when determining the effects.

Many of the studies had a high risk of bias in the domains of random sequence generation, allocation concealment and blinding of participants and personnel. Six of the 11 studies were RCTs, and only four of them described the process and were considered a low risk of bias. As RCTs are considered a high level of evidence, such bias may affect the outcome of the intervention. Randomisation can be challenging when using schools due to possible contamination of intervention information across classes and groups within or across schools close together. High risk of bias in allocation concealment and blinding of participants and personnel could attenuate the effects of the intervention, suggesting that the effects could be greater. Therefore, the risk of bias results must be considered when determining the effect of the interventions on child wellbeing.

As the concept of wellbeing is multidimensional and open to interpretation, it was not possible to include all of the constructs that may be considered applicable. The exclusion of non-journal articles, dissertation abstracts and studies not in English may have also lost potential studies. Due to the small number of studies and large heterogeneity in terms of intervention, sample size and measurement of wellbeing across the studies, it was not possible to conduct a meta-analysis. The method for study extraction and risk of bias would have been further enhanced by including a second researcher along with calculation of the inter-rater reliability of the researchers. However, the inclusion of various positive search terms along with negative search terms of wellbeing will have contributed to an extensive search, and assessing the effect of interventions on both physical activity and wellbeing and their measurement tools enabled an extensive and novel review of this important area of research.

Conclusion

From an initial search of 995 studies, 11 were reviewed showing mixed findings for the effect of physical activity on children's wellbeing in school settings. Methodological inconsistencies were found in both the measurement of wellbeing and that of physical activity. We recommend that future studies incorporate a measure of child wellbeing based on

children's perceptions and that physical activity be measured objectively in order for the links between physical activity and wellbeing to be determined for children.

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